

ABSTRACT

A wellbore drilling system has an umbilical that carries a drill bit in a wellbore. Drilling fluid pumped into the umbilical discharges at the drill bit bottom and returns through an annulus between the umbilical and the wellbore carrying entrained drill cuttings. An active differential pressure device (APD device), such as a jet pump, turbine or centrifugal pump, in fluid communication with the returning fluid creates a differential pressure across the device, which alters the pressure below or downhole of the device. The APD device can be driven by a positive displacement motor, a turbine, an electric motor, or a hydraulic motor. A controller controls the operation of the APD device in response to programmed instructions and/or one or more parameters of interest detected by one or more sensors. A preferred system is a closed loop system that maintains the wellbore at under-balance condition, at-balance condition or over-balance condition.